REMARKS

Claims 1-20 are pending in the application, with claims 5-20 having been withdrawn as a result of an election of invention made by Applicant. Applicant hereby affirms the election of claims 1-4 of Group I, said to be drawn to a solid-state image pickup device comprising a plurality of picture elements including light receiving elements and storage elements. Marked up versions of the replacement paragraphs of the specification and the amended claims are attached hereto pursuant to 37 C.F.R. § 1.121(c)(ii).

In paragraph 6 on page 3 of the Office Action, the Abstract is objected to and is said to be in need of rewriting to describe the elected invention. In response thereto, Applicant is canceling the originally filed Abstract in favor of a new Abstract which is directed to the elected invention.

In paragraph 7 on page 4 of the Office Action, the disclosure is objected to because of informalities on pages 13 and 15. In response, the paragraph on page 13 is being rewritten to refer to "channel region 16" at lines 9 and 10 thereof. In lines 21, 22, 25 and 26 of page 15, the reference to "Fig. 3" is being changed to "Fig. 6". Therefore, such informalities in the specification have been corrected.

In paragraph 8 on page 4 of the Office Action, claims 1-3 are objected to because incident "lights" should be incident "light" in line 19 of claim 1. Therefore, claim 1 is being rewritten to correct this informality. Claims 1-3 should now be clear and definite.

In paragraph 10 which begins on page 5 of the Office Action, claims 1-3 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,121,192 of Kazui, in view of U.S. Patent 5,668,597 of Parulski et al. In paragraph 11 which begins on page 6 of the Office Action, claim 4 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Kazui in view of Parulski et al., and further in view of U.S. Patent 6,288,744 of Takahashi et al. These rejections are respectfully traversed.

In accordance with the present invention, in a first image pickup operation the first set of light receiving elements accumulates electric charges in accordance with incident light, while the second set of light receiving elements does not accumulate charges. In this manner, a thinned-out image signal can be obtained before performing frame transfer to the storage section.

In the case of Parulski et al., in contrast, the image signal is not thinned before performing frame transfer to the storage section. Electric charges corresponding to several lines are eliminated by the fast dump structure 62 after performing frame transfer to the storage section. Therefore, structures in accordance with the present invention are substantially different from those of Parulski et al.

Claim 1 defines a solid-state image pickup device which includes first and second sets of light receiving elements. In the case of the first set of light receiving elements, "at least one of the corresponding transfer electrodes is activated and simultaneously at least one of the transfer electrodes is inactivated in first and second image pickup operations". In the case of the second set of light receiving elements "all of the corresponding transfer electrodes are inactivated in the first image pickup operation, and at least one of the transfer electrodes is activated and simultaneously at least one of the transfer electrodes is inactivated in the second image pickup operation". Therefore, claim 1 is submitted to clearly distinguish patentably over the attempted combination of Kazui and Parulski et al. Similar comments apply to claims 2 and 3 which depend from and further define claim 1.

Claim 4 depends from and further defines claim 1 in terms of "a channel region under the transfer electrode corresponding to said first light receiving element and a channel region under the transfer electrode corresponding to said second light receiving element differ in their concentration of impurities". This defines a feature in accordance with the invention relating to the difference in impurity concentrations between a channel for the first set of light receiving elements P1 and a channel for the second set of light receiving elements P2.

Neither of the light receiving elements P1 or P2 corresponds to a horizontal transfer channel. Consequently, the present invention is not related to the configuration of Takahashi which provides a difference in impurity concentrations between vertical and horizontal transfer channels. Therefore, claim 4 is submitted to clearly distinguish patentably over the attempted combination of Takahashi et al. with Kazui and Parulski et al.

In conclusion, claims 1-4 are submitted to clearly distinguish patentably over the prior art for the reasons discussed above. Therefore, reconsideration and allowance are respectfully requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles telephone number (213) 337-6700 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

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Date: February 19, 2003

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Version with markings to show changes made:

IN THE SPECIFICATION:

On pages 12 and 13, rewrite the paragraph beginning at line 11 of page 12 and ending at line 13 of page 13, as follows:

A P-type diffusion region 12 is formed on one principal face of an N-type semiconductor substrate 11, and a plurality of channel regions extending in one direction (horizontal direction of Fig. 4) are formed parallel with one another in the diffusion region 12. Each channel region forms a transfer route of information charges, and has an N-type embedded layer 13 in the vicinity of its surface, which forms an embedded channel structure. Furthermore, the semiconductor substrate 11 serves as an overflow drain for absorbing the information charges leaking from the channel regions, to which predetermined fixed potentials are applied in accumulating, transfer and discharge periods of the information charges, respectively. A plurality of transfer electrodes 15 extend in a direction intersecting the channel regions and arranged parallel with one another via an insulating film 14 on the channel regions with the embedded layer 13 formed thereon. The transfer electrodes 15 may be formed in a double-layer structure in which clearances in the first-layer transfer electrodes 15 are covered with second-layer transfer electrodes. In a three-phase operation, first and second light receiving elements P1 and P2 each formed of three transfer electrodes 15 are set in the channel regions. In a channel region 16 in which the first light receiving element P1 is set, an N-type doped region 16 having a higher impurity concentration than the embedded layer 13 is formed opposite to the central transfer electrode 15. The [injection] channel region 16 is formed to prevent the information charge from escaping from the embedded layer 13 toward the semiconductor substrate 11, but may be unnecessary if the information charge can be securely held by only the transfer electrode 15.

On pages 15 and 16, rewrite the paragraph beginning at line 4 of page 15 and ending at line 3 of page 16, as follows:

When the information charges are accumulated in the channel regions, the transfer electrodes 15 are activated. Specifically, by raising the electric potential applied to the transfer electrode 15, a potential profile shown by a curve a is formed. Therefore, the information charges can be accumulated only to make up a difference between the minimum value of the embedded layer 13 and the maximum value of the diffusion layer 12. On the other hand, when the information charges are discharged toward the semiconductor substrate 11 instead of being accumulated in the channel regions, the transfer electrodes 15 are inactivated. Specifically, by lowering the electric potentials applied to the transfer electrodes 15, a potential profile as shown by a curve b is formed. Therefore, the information charges generated in the channel regions are discharged toward the semiconductor substrate 11 along a potential gradient. In the first image pickup operation, the transfer clock ϕf2 forms the potential shown by the curve a of Fig. [3] 6, while the transfer clocks ϕf1, ϕf2' and ϕf3 form potentials shown by the curve b of Fig.[3] 6. Additionally, in the second image pickup operation, the transfer clocks ϕf2 and ϕf2' form the potentials shown by the curve a of Fig. [3] 6, while the transfer clocks ϕf1 and ϕf3 form potentials shown by the curve b of Fig. [3]6. The potential on the side of the semiconductor substrate 11 hardly changes because the electric potential applied to the semiconductor substrate 11 is not altered between the first and second image pickup operations.

On page 64, delete the Abstract Of The Disclosure set forth therein and substitute the following new Abstract.

ABSTRACT OF THE DISCLOSURE

A solid-state image pickup device for generating image signals in accordance with incident light includes a semiconductor substrate with a semiconductor region formed on one surface thereof, plural channel regions extending in a column

direction on the region and defining plural picture elements in which electric charges are accumulated, and plural transfer electrodes extending in a row direction on the semiconductor region. The picture elements include light receiving elements accumulating electric charges according to incident light and storage elements for storing charges transferred from the light receiving elements. The light receiving elements include a first set in which corresponding transfer elements are simultaneously activated and inactivated in first and second image pickup operations and a second set in which all corresponding transfer electrodes are inactivated in the first image pickup operation and transfer electrodes are simultaneously activated and inactivated in the second image pickup operation.

IN THE CLAIMS:

Rewrite claim 1 as follows:

1. (Amended) A solid-state image pickup device for generating image signals in accordance with incident light, comprising:

a semiconductor substrate having one conductive type;

a semiconductor region formed on one surface of said semiconductor substrate and having a conductive type opposite to said semiconductor substrate;

a plurality of channel regions extending in a column direction respectively in said semiconductor region;

a plurality of picture elements in which electric charges are accumulated defined in each portion of said plurality of channel regions; and

a plurality of transfer electrodes, extending in a row direction on said semiconductor region, for transferring the electric charges accumulated in said plurality of channel regions, said plurality of transfer electrodes being allocated to each picture element,

said plurality of picture elements including:

light receiving elements in which the electric charges are accumulated in accordance with the incident [lights] light, and storage elements in which the electric charges transferred from said light receiving elements are stored,

said plurality of light receiving elements including:

a first set of a plurality of light receiving elements in which at least one of the corresponding transfer electrodes is activated and simultaneously at least one of the transfer electrodes is inactivated in first and second image pickup operations; and

a second set of a plurality of light receiving elements in which all of the corresponding transfer electrodes are inactivated in the first image pickup operation, and at least one of the transfer electrodes is activated and simultaneously at least one of the transfer electrodes is inactivated in the second image pickup operation.